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ABSTRACT

The study was designed to determine how standard science skill builder activities can be modified or adapted for use by orthopedically handicapped students. Nine secondary level science experiments were selected for initial review and from these, three were selected for adaptation--use of the microscope, use of graduated cylinders, and use of the balance. Each of the activities were modified in terms of three levels of involvement of orthopedically handicapped: mildly involved--defined as ambulatory with or without assistance, use of one or both hands, can be an active participant in the experiment; moderately involved--confined to a wheelchair, use of one or both hands, may have muscular dysfunction, may have a moderate degree of participation and may need some assistance in the experiment; and severely involved--confined to a wheelchair, minimal use of hands and a high probability of being a passive participant in the experiment. As each skill builder activity was conducted as it would be in an average secondary school, task analyses were conducted to identify possible problems that might occur when the activities are being performed by orthopedically handicapped learners. (The revisions of the adapted skill builder activities appear in their final form in the last section of the document with sections on use of each instrument, preskills needed, expected outcome, experimental steps, adaptations needed for each level of involvement, major equipment modification, and demonstration of learning.) (SBH)

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Three Adapted Science Skill Builders for Junior And Senior High School Orthopaedically Handicapped Students

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Introduction

It has been recognized for many years that all members of society have a right to achieve at a level commensurate with their interests and abilities. One group, whose circumstances are improving as a result of recent changes in federal legislation, are the physically handicapped.

With the implementation of the least restrictive placement section of Public Law 94-142 more orthopaedically handicapped children will be educated in regular classroom settings. This includes the sciences - Chemistry, Physics, Biology, and Natural Science - in which experimentation is an integral part of the classroom. The objectives for including the orthopaedically handicapped student in science classes are the same as for able bodied students. Orthopaedically handicapped students need to learn about themselves and the world about them. They also need to have the opportunity for vocational choices in the science areas.

Indeed the review of the literature demonstrates an emerging need to develop adaptations in science curricula for the orthopaedically handicapped student. The adaptations must meet the needs of the student as well as the academic requirements of the school.

The purpose of this study was to determine how standard science skill builders activities can be modified or adapted for use by orthopaedically handicapped students. A committee of special and regular science educators selected three basic skill builders activities (1. Use of a microscope, 2. use of graduated cylinders, and 3. use of balance) and adapted and modified them for use with orthopaedically handicapped students.

Review of the Literature

The American Association for the Advancement of Sciences (AAAS) has been studying the participation of handicapped persons in science. Initially, AAAS conducted a survey to determine what science programs already existed for handicapped students. What was found was a dearth of science programming for handicapped students. (Powers, 1977) Programming in science for handicapped students has traditionally been exemption rather than participation for those students attending regular schools. Special schools often don't have science programs at all. (Rawls, 1978)

Recently programs have been developed for students with various types of handicapping conditions. Dr. Doris Hidary of American University has developed programs for blind, deaf, and emotionally disturbed children. (Hidary, 1975) Other programs have been developed for educable mentally retarded students. (Science Teacher, 1975)

On the collegiate level, physics labs and physical science courses have been developed for blind students. Baughman and Zollman (1977) have adapted equipment normally found in the physics laboratory for the blind student who may enroll in a physics course. Weems, (1977) on the other hand, has reported the development of a physical science course for an entire class of blind students.

West Virginia University is currently involved in an experiment in Marine Biology and Oceanography for handicapped secondary school students. These students are orthopaedically impaired, blind or deaf; are honor students; and come from across the country. They spend six weeks on the Atlantic Ocean at the Marine Science

Center studying ocean life. (Greenfield, 1978)

Dr. Hidary has also developed teacher strategies and adaptations of commonly used science kits for use by mainstreamed handicapped students. Her work is based on Dr. Herbert Thayer's adaptation of existing elementary science materials for handicapped children. (Powers, 1977, p. 39)

Throughout the literature there was little to be said about in-school science programming for secondary level orthopaedically handicapped students who have been mainstreamed. It was this finding that brought the authors to this project. There is a need to assist regular science teachers in providing hands-on, quality science programming for those orthopaedically handicapped students who are mainstreamed.

Procedure

Nine secondary level science experiments were selected for initial review. The experiments were evaluated in terms of the following criterea; 1) adaptability of equipment, 2) amount of pre-experiment reading and information gathering required, 3) can the teacher adapt other experiments on the basis of these experiments? (generalizability and usefulness), 4) is the experiment appropriate for the secondary level?, 5) is the adaptation and modification of the equipment cost prohibitive?, and 6) what other experiments of a similar nature might be conducted and still maintain the same objective?

After a thorough review of these experiments by the project participants, it was decided that the most effective course of action would be to modify a number of basic skill builder activities.

The rationale for this was a follows: 1) these science activities have a high intrisic scientific value, 2) they are basic to all other science experiments and scientific endeavors, 3) they have a high vocational value and are crucial in terms of skills needed to adapt an increasingly more complex society, and 4) the probability of easily modifying them was quite high - thus making for a highly effective use of the project's resources.

An additional review of the original experiments was conducted and at a brainstroming session three science skill builder activities were selected based upon the afore mentioned criteria and the generalizability and scientific importance of the skills developed in these activities. The science skill builder activities selected for adaptation were 1) Use of the microscope, 2) Use of graduated cylinders, and 3) Use of the balance. Each of the original activities were modified in terms of three levels of involvement of orthopaedically handicapped students; 1) mildly involved, defined as ambulatory with or without assistance, use of one or both hands, can be an active participant in the experiment, 2) moderately involved, defined as confined to a wheelchair, use of one or both hands, may have muscular dysfunction (muscle weakness, ataxia, or tremor), may have a moderate degree of participation in the experiment and may need some assistance in the course of the experiment, and, 3) severely involved, defined as confined to a wheelchair, minimal use of hands and a high probability of being a passive participant in the experiment.

Each skill builder activity was conducted as it would be in an average secondary school laboratory setting. As the skill

builder activity progressed, task analyses were conducted in order to identify possible problems that might occur when the activities are performed by orthopaedically handicapped learners. Modifications which resulted from the task analysis then correlated with each level of handicap. The final recommendations for each group of orthopaedically handicap related to changes in experimental procedures, modifications or substitutions of materials and equipment, and more effective utilization of available resources, i.e. student aids, tutors, paraprofessionals. Each modification was made so as to perserve the unity and basic objectives of the activity. In addition, safety and feasibility of the changes were primary considerations. Lastly, one of the most important guidelines was the need to provide the handicapped learner with the intrinsic experience of being involved in a science experiment and to facilitate the greatest possible overt involvement in this kind of educational experience.

In order to gain the perspective of an educator working in the secondary science area, the modified activities were given for a final review and critique to Mr. Jerry Braun, Supervisor of Secondary Science Programs, Cincinnati Public Schools. Mr. Braun's comments and suggestions were incorporated into the final revisions of the science skill builder activities.

The revisions of the adapted skill builder activities appear in their final form in the next section of this document.

Basic Skill Builder

1. Microscope

I. Using A Compound Microscope

II. Introduction

Students in science need to be able to use a microscope in in Biology as well as Natural Science courses. It may sometimes be used in Chemistry to determine effects of chemicals on organic substances. For this reason this basic skill was chosen for adaptation for use by orthopaedically handicapped students.

III. Preskills Needed

1. Identification of the parts of a compound microscope.
2. Identification of the functions of those parts.
3. Identification of how those parts are manipulated.

IV. Expected Outcome

The student will be able to use or verbally direct the use of a microscope.

V. Experimental Steps

1. Turn the nosepiece so that the low-power objective is in line with the body tube. It should click into place.
2. Prepare a dry mount to be viewed through the microscope.
3. Place the prepared slide on the stage of the microscope, under the low-power objective.
4. Look at the microscope from off to one side and use the coarse adjustment to lower the body tube until the low-power adjustment <u>almost</u> touches the slide.
5. Look through the eyepiece and turn the coarse adjustment knob toward you. Continue to raise the body tube until your specimen comes into focus. Now turn the fine adjustment to make the focus as sharp as possible.
6. To observe your specimen under high power, raise the body tube before changing from low to high power. Turn the nosepiece until the high-power objective snaps into place under the body tube.

7. Repeat Step 4 of this procedure using the high-power lens. Be sure the high-power objective does not touch the slide. Never turn the coarse adjustment to move the high-power objective downward.

8. You may have trouble with this procedure, so don't be alarmed. If after several trials you can't focus your microscope, ask your teacher to help you.

VI. Adaptations Needed

1. Mildly involved students

   A. Optimum desk height for viewing and manipulating the microscope. This may involve a low table, desk, bench, or chair to put the microscope on so the student in a wheelchair can be above the eyepiece. For the student on crutches, this may mean a table with height suitable for standing.

   B. Use of non-skid surface or attachment of the microscope to the desk to prevent movement/breakage of the microscope.

   C. Use of plastic slides instead of glass slides to prevent breakage and injury.

   D. Use of plastic slides instead of cover slips for easier maneuverability.

   E. Use of a lubricant type substance (Vaseline) to make a resistive film on the stage. This would enable the student to keep the slide on the stage.

   F. Instead of using a lubricant substance, a mechanical stage can be used for those students who can adjust the microscope.

2. Moderately involved students

   A. Optimum desk height for viewing and manipulating the microscope. Some type of well could be constructed to permit the work area of the desk to be level with the stage of the microscope. This would allow easy movement of the slide from the work area to the stage.

   B. Attachment of the microscope to the well of the desk.

   C. Due to involvement of the student the dry mount may have to be made by the teacher or another student. This should be done with verbal instructions by the handicapped student. The student should be encouraged to do as much as possible.

D. Placement of the slide on the stage--the student should slide the dry mount from the desk onto the stage, or the teacher or student helper places the dry mount on the stage.

E. The student may need assistance for adjustment of the objective, but can give direction for both coarse and fine adjustment.

F. The student may need assistance in manipulation of the objective power but can give direction.

3. Severely involved students

Severely involved students will need assistance in all areas but will be able to give direction to the teacher or student helper. For more complete involvement of the severely involved student in the procedure, major equipment modifications will need to be made. See VII.

VII. Major Equipment Modifications

These modifications can be made to enhance independent functioning of the orthopaedically handicapped student. Some of the modifications are inexpensive and only require a little time in the workshop. Others are more involved and may have to be purchased.

1. On/Off Switch -- a push button switch mounted on the cord of the microscope and firmly attached to the table.

2. Headrest -- a sturdy headrest, possibly with a chin support, attached to the neck of the microscope.

3. Eyepiece -- a large molded rubber eye piece attached to the eyepiece of the microscope for increased stability.

4. Desk edge -- attach a ridge board (1x1x1 inch) along the edge of the desk to help prevent breakage and movement.

5. Desk well -- construct a well in a desk so that the stage of the microscope is at the same level as the work area of the desk. The work area will need to be of substantial size on both sides of the well so that slides can be prepared and smoothly glided onto the stage. The microscope must be firmly attached to the well. This can be done with bolts, clamps, etc.

6. Adjustment --
   Coarse - attach a small metal rod (¼ inch in diameter) to the adjusting knob. This rod if moved through a 90° angle rotation would be sufficient to raise the low power objective enough to allow the placement of a slide on the stage for viewing.

   Fine - some sort of electrically operated focusing mechanism similar to the self-focusing device on a Carrosel slide projector would need to be attached to the microscope.

7. Slides -- use plastic slides instead of glass slides.

8. Slide holder -- mount the slides in some type of tray or holder. This holder could possibly be made from a piece of Lucite that is rectangular in shape (4 x 6 inches) and about ¼ inch thick. The slide would be permanently mounted in this holder.

9. Stage clips -- remove. Coat the surface of the stage with some type of lubricant (Vaseline). This will ease movement of the slide and will also keep the slide from being knocked off the stage.

10. Objectives -- attach a handle to the nose piece to make changing of the objectives easier. A rod could be attached perpendicularly to the axis of the rotation of the objective and be up to six inches in length.

11. Restraining cuffs -- can be used to control extraneous hand movement. These can be made with about eight inches of one ince wide Velcro attached to a heave magnet. A metal (steel) working area would be needed to utilize the cuffs.

12. Pointer/Manipulator -- A wooden towel rod with rubber tips on both ends to be used by the student to manipulate the slide on the stage. The student holds the rod firmly in his/her teeth.

13. Projector microscope -- this microscope projects a large image of the speciman on a screen. This could be used for group instruction.

14. Television microscope -- this microscope has a television screen.

VIII. How Learning Is To Be Demonstrated

1. Mildly -- Actual use of the microscope as well as preparation of a dry mount.

2. Moderately -- May be the same as for the mildly involved student. But, this student may need some assistance. The student should be encouraged to do as much as possible.

3. Severely -- This student will probably have to verbally direct the evaluator (teacher) through the proper procedure for using the microscope and preparing the dry mount. The student should be encouraged to do as much as possible.

Basic Skill Builder

2. Graduate

I. Measuring With A Graduate

II. Introduction

Liquids are usually measured with the use of a graduated cylinder. The liquid is poured from a container into the narrow mouth of the graduated cylinder, measured and then poured into some other container. The problems encountered include difficulties necessitated by having to keep the liquid surface in the cylinder at eye level, the unstable nature of the equipment, the great probability of pouring too much liquid into the cylinder, and the corrosive nature of many liquids.

III. Preskills Needed

1. Knowledge of the metric system.
2. Identification of a graduated cylinder and a graduated beaker.

IV. Expected Outcome

The student will be able to measure liquids or verbally direct the measurement of liquids using a graduate.

V. Experimental Steps

1. Pour a liquid into a graduated cylinder.
2. Measure the liquid.
3. Pour the liquid into another container.
4. Pour a liquid into a graduated cylinder to a specified volume.
5. Add or pour off liquid to bring the volume to the specified amount.
6. Pour the liquid into another container.

VI. Adaptations Needed

1. Mildly involved students
   A. Small container sizes -- no larger than 400 ml.
   B. Containers should have handles.

C. Containers/graduates should be made of polypropylene or acrylic plastic.

D. Graduated cylinders should be marked with large, easily detected numerals and divisions.

E. Practice measuring techniques in graduated beakers using water before using the more accurate apparatus.

2. Moderately involved students

A. See adaptations for mildly involved students.

B. Use 50 ml graduated cylinders instead of 100 ml graduates to lessen possible spillage and to reduce the height to which a student must lift the liquid above the work surface.

C. To measure small amounts of a non-corrosive liquid use a modified syringe with a large handle on the plunger and finger grips on the barrel.

D. To provide a larger area in which to pour a liquid into a graduate a funnel may be used. (See equipment modifications.)

3. Severely involved students

Severely involved students will need assistance in all areas but will be able to give direction to the teacher or student helper. For more complete involvement of the severely involved student in the procedure major equipment modifications may need to be made. See VII.

VII. Major Equipment Modifications

These modifications can be made to enhance independent functioning of the orthopaedically handicapped student. Most of the modifications are inexpensive and only require a little time and imagination.

1. In all situations use plastic except where the substance used will destroy the plastic.

2. To better mark divisions on the graduated beakers and cylinders use brightly colored fabric tape placed beside/over the markings on the graduate.

3. To secure a funnel over a graduated cylinder, first attach a ring stand to the work surface. Then firmly attach a funnel to an iron ring on the ring stand just above the mouth of the graduated cylinder. To secure the graduated

cylinder to the base of the ring stand, attach a quarter-inch thick sheet of plastic with a hole cut through the plastic directly under the funnel. The graduated cylinder base fits into the hole and will be lined up under the funnel.

4. To measure small amounts of non-corrosive liquids modify a syringe by attaching a large handle and finger grips on the barrel. The grips may simply be some fabric tape applied to the barrel. Corrosive liquids should not be used with the syringe due to the possibility of accidentally expelling the liquid into the air or onto another student.

5. For some orthopaedically handicapped students the difficulties of lifting containers of liquids to the hieght of the funnel and the increased possibility of pouring too much liquid into the cylinder would require the use of an acrylic burett with a spring loaded stop-cock firmly attached to a ring stand. The ring stand should be firmly attached to the work surface. Attach an elongated handle to the stop-cock. Filling the burett would be accomplished by the teacher or student helper. The increased accuracy of the burett would greatly decrease the chance of withdrawing a significantly lesser or larger quantity of the liquid. A burett type delivery device with a reservoir may be desirable.

VIII. How Learning Is To Be Demonstrated.

1. Mildly involved students will actually measure liquids using a graduated cylinder.

2. Moderately involved students may actually measure the liquids. But, the student may need some assistance. The student should be encouraged to do as much as possible.

3. The severely involved student will probably have to direct the evaluator (teacher) through the proper procedure for measuring liquids with a graduate. The student should be encouraged to do as much as possible.

Basic Skill Builder

3. Balance

I. Using a Balance

II. Introduction

Many experiments are based on the weighing of ingredients before mixture and completion of the experiment. Because of the need to weigh dry ingredients, this procedure has been included in this series.

III. Preskills Needed

1. Identification of the balance and its parts.

2. Knowledge of the metric system.

IV. Expected Outcome

The student will be able to weigh dry items/ingredients or verbally direct the weighing of dry ingredients using a balance.

V. Experimental Steps

1. Check to be sure all of the riders are at the zero point on all of the beams.

2. Check to be sure the pointer is on the zero mark. If not, turn the adjustment screw until the pointer is on zero.

3. Place the item to be weighed on the pan. Move the riders to the right until the pointer is on the zero mark.

4. Add up the figures on all the beams where the riders are resting. The total is the weight of the object on the pan.

5. If the pointer is below the zero mark you have moved one or all of the riders too far to the right. Move one or all of the riders to the left until balance is achieved.

6. If the pointer is above the zero mark, you have not moved the riders far enough to the right. Move one or all of the riders to the right until balance is achieved.

7. If the pointer cannot be zeroed, even if you have all the riders as far right as possible, then check the following:

a. The item is too heavy for the balance you are using. Use a balance that weighs heavier objects.

b. Remove the object from the pan and check to see if the balance is properly zeroed. See Step # 2.

VI. Adaptations Needed.

1. Mildly Involved Students

A. Single pan, low form, triple beam balances seem to be the most stable, easiest to lead, and facilitate quick and accurate measurements.

B. For gross measurements use a spring platform balance.

C. Balances should have large, easy to read numbers and indicators.

D. If possible, attach the balance firmly to the work surface.

E. A work surface adjacent to, the same height as, conforming to the shape of the balance pan might be constructed. This will allow for easy transfer of objects to and from the pan.

F. A locking mechanism should be incorporated into the design of the balance to keep the pan steady for loading and unloading.

2. Moderately Involved Students

A. See adaptations for mildly involved students.

B. Beam weights might need to be modified to allow for easy and non-jamming movement along the beam.

C. A funnel could be built into the work platform to aid in the transfer of weighed powders to other containers.

D. Cups and containers used in the weighing process should have handles.

E. Containers should be lightweight.

F. Table height might need to be adjusted in order to bring the balance pan to a convenient working height.

G. Zeroing of the balance might need to be done by the teacher or lab partner.

H. Pouring the item to be weighed onto the balance pan might need to be done by the teacher or lab partner.

3. Severely Involved Students

Severely involved students may need assistance in all areas but should be able to give direction to the teacher or student lab partner. For more complete involvement of the severely involved student in the procedure, major equipment modifications may need to be made. See VII.

VII. Major Equipment Modifications

1. Consider using a direct read balance.

2. A well in the desk which placed the balance pan at the height of the work surface could be constructed.

3. A lock for the balance pans could be added. This would enable the pans to be loaded by sliding items from the work surface without moving the balance pan.

4. Make numbers and indicators large and easy to read.

5. Attach a funnel to the work surface. After a powder/ingredient has been weighed, the student can lock the balance pan, slide the ingredient off the pan and into the funnel and into a container. This allows for easy transfer from the pan to a usable container.

VIII. How Learning Is To Be Demonstrated

1. Mildly involved students will carry out the experimental steps for weighing with a balance.

2. Moderately involved students may actually weigh items using the balance but may need some assistance.

3. The severely involved student will probably have to direct the evaluator (teacher) through the proper steps for weighing items using the balance. The student should be encouraged to do as much as possible.

Conclusions and Recommendations

1. Refine and further develop, modify and adapt how to use a microscope, measuring with a graduate and using a balance for orthopaedically handicapped students.
2. Need to develop additional skill builder activities for students with orthopaedic conditions.
3. Develop, modify and adapt basic scientific experiments for orthopaedically handicapped students.
4. Document science activities for the orthopaedically handicapped through video tapes, slides and publications.
5. Disseminate and share information to professional personnel through workshops, in service instruction, state and national conferences and certification preparation.
6. Develop a register of handicapped scientists, local, regional, state and nationally.
7. Develop a catalogue of special equipment and technology to be used with the orthopaedically handicapped for science activities.
8. Recommend science textbook companies to provide information regarding modifying and adapting science activities for the orthopaedically handicapped.
9. Architectural barriers should be removed when developing laboratories and utilizing scientific equipment with orthopaedically handicapped students.

Bibliography

Baughman, James and Zollman, Dean. "Physics labs for the blind." The Physics Teacher, 15, 1977, 339-342.

Biological Sciences: Invitations to Discovery. Prepared by The Biological Sciences Curriculum Study. Holt, Rinehart and Winston, Inc. New York, 1975, 316-323.

Greenfield, David. Science program for handicapped. Charleston Daily Mail, W. Va., May 9, 1978, p. B-1.

Hidary, Dorio E. "Picking up good vibrations from science for the handicapped." The Science Teacher, 1975, 42, pp. 12-13.

Powers, Linda. "Science and art in mainstream education: Toward the normalization of the handicapped child." Amicus, June, 1977, 37-40.

Rawls, Rebecca L. "Easing the way for handicapped in science." Chemistry and Engineering News, 1978, 56, pp. 25-27.

_____. "Science for the handicapped - finally!" The Science Teacher, 1975, 42, p. 26.

Weems, Bruce. "A physical science course for the visually impaired." The Physics Teacher, 15, 1977, 333-338.